

Hashal Sami Mohammad Al-Basri^{1,2}, Stephen Fallows²

The Mediterranean Diet is not related to depression, anxiety and stress among young university students in the UK: a cross-sectional study

¹ Medical doctor (MD)/ Iraqi Medical Association.² Dept of Clinical Sciences and Nutrition, University of Chester, Chester, UK.

*email: hashalsami@gmail.com

Received: 2022-12-16; Accepted: 2023-03-29

DOI: 10.52095/-----

Abstract

Objectives: Mental health conditions such as stress, anxiety, and depression represent a burden on society as they contribute to morbidity and mortality among affected people. The prevention of mental health disorders through promoting a healthy lifestyle and early therapeutic interventions among affected individuals may reduce treatment expense and save lives. Various epidemiological studies have investigated the relationships between dietary patterns, nutrients, and mental health disorders.

We intend to evaluate the effects of specific eating habits i.e. the Mediterranean diet on the mental health of university students in the UK (18- 35 years old), and the influence of multiple variables such as age, gender (male/female), level of study (undergraduate/postgraduate), nationality (British/European versus international) on the prevalence of mental health disorders. The main study hypothesis assumes that there is a significant relationship between the Mediterranean diet and mental health disorders (depression, anxiety and stress) among young university students.

Methods: The study design is a descriptive analytical cross-sectional study. Data from 125 students, recruited from the University of Chester were collected and analysed. The adherence to the Mediterranean diet was determined using the 14-item Mediterranean diet score tool. Depression, anxiety, and stress symptoms among the participants were assessed using a self-report 21-item questionnaire (DASS-21). The relationship between each of the mental health disorder scores obtained by the DASS-21 and the adherence to the Mediterranean diet was investigated.

Demographic data was collected from the students, namely: age, gender, educational level and nationality. The scores of mental health disorders (stress, anxiety, and depression) obtained by DASS-21 and its dependence on students' demographic parameters were also investigated.

Results: There was no significant correlation between the Mediterranean diet score tool and DASS- 21 parameters stress ($P = .16$, $r = .13$), anxiety ($P = .07$, $r = .16$), and depression ($P = .06$, $r = .17$), among young university students in the UK and adherence to the Mediterranean diet eating habits was low. However, moderate wine consumption may be protective against some mental health symptoms. Furthermore, depression levels were not dependent on the participants' socio-demographic variables and anxiety levels were dependent on the participants' study level (undergraduate versus postgraduate, $P = .008$, $Z = -2.6$), and their home backgrounds (British/EU higher than Internationals, $P = .007$, $Z = -2.7$). Moreover, stress levels were dependent on two variables: gender (females higher than males) ($P = .035$) and nationality (British/ EU higher than international students) ($P = .007$). On the contrary, age groups i.e. 18-25, 26-30, and 31-35 did not influence depression ($P = .96$, $df = 2$), anxiety ($P = .305$, $df = 2$), or stress levels ($P = .09$, $df = 2$).

Conclusion: The University of Chester's young students were only slightly to moderately adhering to a Mediterranean diet. There was no association between the Mediterranean diet eating patterns and mental health disorders among this group though moderate wine consumption recommended by the Mediterranean diet, may be protective against stress, anxiety, and depression symptoms. A fundamental consideration is that levels of these symptoms may be dependent on different socio-demographic variables.

Keywords

Mediterranean Diet, Stress, Anxiety, And Depression, University Students, Cross-Sectional Study

INTRODUCTION

Mental health conditions such as stress, anxiety, and depression represent a burden on society as they contribute to morbidity and mortality among the affected people. Depression has been associated with the loss of healthy years during life by causing disability and increasing the mortality rates (Fresán, et al., 2019).

Mental health disorders represent an economic and social burden on societies, therefore, the role of diet in the prevention of depression has been analysed over the years. For example, the consumption of food that contains omega-3 fatty acids and a plant-based diet in addition to cutting processed food has been associated with lower rates of mental health conditions (Wani et al., 2015).

Mediterranean diet

A Mediterranean diet represents a high consumption of vegetables, fruits, legumes, unrefined cereals, and moderate consumption of fish, dairy products, wine, and minimum consumption of meat (Hoffman & Gerber, 2012). The main dietary fat in the Mediterranean diet is olive oil. The Mediterranean countries surround the Mediterranean Sea which is located between three different continents (Europe, Asia, and Africa). It is agreed that there is no single specific Mediterranean diet (Hoffman & Gerber, 2012). The biodiversity of the Mediterranean countries in aspects of social customs, religion, cultural beliefs, and history influences dietary habits (Hoffman & Gerber, 2012). The geographical distribution of the Mediterranean countries and mainly the climate can represent other fundamental effects on the dietary habits in the area (Hoffman & Gerber, 2012). For example, the consumption of fish in the Mediterranean countries relies on the proximity to the sea and the availability of fishing resources. Olive oil which is the core ingredient in the Mediterranean diet varies enormously between Mediterranean countries (Hoffman & Gerber, 2012). It is believed that the Mediterranean diet which contains nutrients such as mono-unsaturated fatty 3 acids, Vitamin B12, folate, and antioxidants (vitamin E, carotenoids, flavonoids) is protective against dementia and protects against the deterioration in the cognitive functions among the elderly (Argyropoulos & Machini, 2019).

In summary, the main components of Mediterranean diet include:

- Daily consumption of vegetables, fruits, whole grains, and healthy fats.
- Weekly intake of fish, poultry, beans, and eggs.
- Moderate portions of dairy products.
- Limited intake of red meat.

Stress

Stress is a natural feeling of being overwhelmed and incapable of coping with daily pressures (NHS, 2019). The physical and psychological (emotional and mental) limits of a stressed person are stretched and reach the maximum which in the long-term might affect energy levels and the general mental well-being (Seyle, 1955). Stress is also considered as a natural body response to a threatening situation or pressure. The body releases stress hormones (adrenaline and cortisol) as a reaction to mental and emotional pressure which encourages the person to be more motivated or cause some physical symptoms such as an increase in the heart rate and sweating which might be problematic if a person is always stressed (NHS, 2019). This variation in response is defined as a fight-or-flight response of stress. Stress can influence the way a person thinks, feels, and behaves. There are common signs and symptoms of stress such as finding it difficult to relax, lack of concentration, making irrational decisions, or even facing difficulties in making decisions and being irritable and impatient (Seaward, 2017). The physical signs of stress include a fast heart rate, sleeping problems, muscle tensions, loss of appetite, and loss of sex drive (reduced libido).

A panic attack is a condition when a person feels that his/her heart is racing or pounding (heart palpitations) in addition to excessive sweating, short of breath and trembling as a consequence of high levels of stress and anxiety. Almost half of all employees in Britain suffer from stress at work, and more than 13 million working days are lost annually because of stress (Jackson, 2016). The cost of workplace stress on the economy is above £4 billion per year (Jackson, 2016). The easiest way to relieve stress is by identifying the causes and dealing with them. The causes can be, for example, pressure from the workplace, being unemployed, financial issues, illness, loss of someone (bereavement), family or other relationship issues. Addressing these issues and developing emotional resilience may help a person to adapt and bounce back during tough times.

Anxiety

Anxiety is defined as a feeling of unease, nervousness, worry, and fear from an uncertain outcome which can vary from mild to severe (Spielberger 2013) and (NHS 2018). Every person has experienced anxiety throughout their lives. For instance, it is completely normal that people might feel anxious in challenging situations such as exams, job interviews, and presentations. However, some people find it difficult to control their worries and reach the point where these feelings might hinder them from achieving their goals. Anxiety is a symptom of various disorders such as phobia (claustrophobia and agoraphobia), panic disorder, post-traumatic stress disorder, and social anxiety disorder (social phobia) (Manfredini et al., 2005). A constant feeling of anxiety might develop into generalised anxiety disorder (GAD) a long-term condition when the person may be unable to relax and feels anxious about multiple events and issues in their lives (Behar et al., 2009). It is expected that 5% of the population in the UK suffer from GAD. In the UK, GAD affects women more than men and most of the affected people are aged between 35 and 59 years old (NHS, 2018). The symptoms of GAD vary from person to person: some might experience one or two symptoms, while others might suffer from many, such as: feeling on edge constantly; restlessness; irritability; difficulty in concentration; and a sense of dread. These feelings might hinder the affected person from socialising with family and friends and might even affect them to the point where they find it difficult to go to work or school. People with GAD find daily life activities worrying and stressful and sometimes they have very low self-esteem. Apart from the emotional symptoms of GAD, there are some physical symptoms of anxiety that a person with GAD might experience with or without a trigger such as tiredness, headache, sweating, irregular or fast heartbeat (palpitations), shortness of breath and difficulty in falling asleep (insomnia) (Behar et al. 2009). Anxiety triggers can be specific phobias like claustrophobia (Vadakkan & Siddiqui, 2019) which is fear of confined spaces or agoraphobia which is the fear of situations where escape is difficult, such as going to a shopping mall, travelling on public transport, and leaving home. Some people assume that agoraphobia is a fear of open spaces, however, the definition of it is more complex when the person might not be able to leave the house without experiencing a panic attack. In some cases, it can be hard to distinguish GAD from depression. A GAD diagnosis requires some

criteria, namely: worries affect a person's daily life; extremely stressful worry; a tendency to think the worst; uncontrollable worry; and feelings of worry almost every day for at least six months (NHS, 2018). Cognitive-behavioural therapy CBT and the application of various relaxation techniques are considered the treatment of choice for GAD, in addition to some medications in specific cases (Barlow, et al., 1992). There are alternative methods to ease the symptoms of GAD which include: self-help; exercising regularly; adapting some relaxation techniques (yoga); smoking cessation; and enrolment in support groups which include people with a similar condition (NHS, 2018).

Depression

Depression is one of the most common mental health problems affecting more than 264 million people all over the world (WHO, 2020). The prevalence of depression is estimated to be 4.4% worldwide and 4.5% in the UK (NICE, 2020). It causes tiredness, difficulty in concentration, disturbance in a patients' sleep, or appetite which contribute to the global burden of the disease (Angst & Dobler-Mikola, 1984). Depression is considered the leading cause of disability (Friedrich, 2017), and of premature death among young people aged 18-44 years (NICE, 2020). There are some characteristics of depression that vary between emotional, cognitive, and behavioural symptoms. Depression symptoms might be long-lasting or occur in bouts which can drastically affect a person's ability to live a productive life (WHO, 2020). The loss of the positivity effect represents itself in the lack of self-care, anxiety, low mood, and lack of interest in most activities (anhedonia) (NICE, 2020). There are many causes for depression which are a mixture of interactions among social, biological, chemical, genetics, and psychological factors (WHO, 2020). However, there are some life events that act as a catalyst for the development of depression. For instance, loss, psychological traumas, or being unemployed. There has been increased attention on depression among specific groups such as teenagers and elderly people; however, concern about depression in university students is little despite mounting evidence of a steady rise in the number of depressed university students (Ibrahim, et al., 2013).

Depression in early life is linked to many negative consequences that accumulate throughout the years and impair adult life. For instance, depression has negative ramifications on a person's academic performance, social life, relationships, career

prospects and ultimately might imprison the affected person with suicidal thoughts or even attempts of self-harm or suicide. Youngsters are the future of the community and the potential leaders (Ibrahim, et al., 2013). Thus, tackling the issue of mental health disorders among young students can ensure a prosperous future for the country. Many university students experience depression symptoms during the course of their studies which affect their educational performances negatively. The mean annual prevalence of depressive disorders is higher by 30.6% among university students in comparison to the general population (Ibrahim, et al., 2013). According to Ibrahim, et al. (2013), students privileged socioeconomically and demographically are less likely to suffer from depressive symptoms, such as students from affluent families or those who have educated parents, unlike students from deprived areas.

Diet and mental health

Evidence about the relationship between mental wellbeing and Mediterranean diet eating habits was abstracted from previous research (Dietitians of Canada, 2018). However, the mechanism of the diet's protective effects against psychiatric disorders, if there are any, are still equivocal, and extremely complex and require further investigation (Mofrad, et al., 2020).

Nutritional neuroscience is an emerging multidisciplinary field that aims to understand the nutritional impact on brain health across an individuals' life span (Kiecolt-Glaser, et al., 2014). Nutritional neuroscience focuses on the influences of various dietary ingredients on the brain functions which include the neurochemistry, neurobiology, cognitive functions of the brain, and people's behaviours (Kiecolt-Glaser et al. 2014). However, social nutritional neuroscience has a wider view in the aspects of dietary habits such as social background and behavioural impacts on eating habits which ultimately have effects on the neurochemistry and neurobiology of the brain (Kiecolt-Glaser, et al., 2014). It is believed that a feedback loop can be created as the dietary, biochemistry and biological changes might alter social and behavioural perspectives. Therefore, research that investigates the relationship between diet and its biological consequences on depression may be better illustrated as a two-way street.

The present study investigates the hypothesis that

there is a relationship between the Mediterranean diet and mental health disorders, i.e. stress, anxiety and depression among young university students.

Exploratory data analysis explores the relationships between mental health problems and sociodemographic characteristics of the student population.

MATERIAL AND METHODS

The study design was a cross-sectional descriptive-analytical study. Cross-sectional studies are described as "one-shot or status studies" (Kumar, 2011). This type of study design was preferred in the present study because it aims to obtain a general picture of the prevalence of a phenomenon, situation, behaviour of the studied population at the time of the study (Kumar, 2011). The cross-sectional study design is frequently used in social sciences because they are easy to analyse and relatively cheap (requires only one contact with the participants). However, researchers cannot measure change among the studied population over time (Kumar 2011).

Study Sample

The data were collected from 125 students, aged between 18-35 years old, of the University of Chester, Chester. There was no bias in recruiting the participants. The sample size was calculated according to the Krejcie formula (Krejcie & Morgan, 1970).

Inclusion Criteria

- All students enrolled at the University of Chester, irrespective of their gender, ethnicity, financial status, study department, and nationality.
- Young participants between 18 and 35 years old.

Exclusion Criteria

- Students from different universities in the UK.
- Staff members at the University of Chester were excluded, for instance, lecturers, tutors, and librarians.
- Students younger than 18 years old and students aged more than 35 years old.

Table 1 summarises the participants' demographic characteristics.

Table 1. Participants' Demographic Variables

Variable	Frequency	Percentage
Age		
18-25 years	100	80%
26-30 years	16	12.8%
31-35 years	9	7.2%
Gender		
Males	30	24%
Females	93	74.4%
Prefer not to say	2	1.6%
Study level		
Undergraduate	101	80.8%
Postgraduate	24	19.2%
Nationality		
British/EU students	99	79.2%
International students	26	20.8%

Diagnostic Instruments

Three questionnaires were completed by all participants:

1-Socio-demographic variables questionnaire

2-Mediterranean diet score tool

3- Depression, anxiety, and stress scale questionnaire (DASS-21).

Students were approached directly by the researcher and were invited to complete the questionnaires after taking their informed consent to participate. A brief explanation about the purpose of the study was provided to the participants with the questionnaire form. Few participants experienced difficulties answering the questionnaires. If necessary, a proper explanation was provided to the participants regarding vague questions and unclear sections in the questionnaire form.

Demographics

The demographic questionnaire was used to collect basic socio-demographic data of the participants such as age (divided into three age groups 18-25, 26-30, 31-35 years old), gender (male, female, prefer not to say), study level (undergraduate, postgraduate), and origin of the participant (home-based student

i.e. British or EU, versus international student).

Dietary assessment

The second section, the 14-items Mediterranean Diet Score tool was used to assess participants' adherence to the Mediterranean diet (Hornby & Paterson, 2013).

The 14-item questionnaire tool was developed in a case-control study in Spain that aimed to assess the reduction in the risk of myocardial infarction incidence achieved by the Mediterranean diet eating habits (Martínez-González, et al., 2002). The questionnaire tool was adapted from tools produced by Hornby and Paterson (British Association for Cardiovascular Prevention and Rehabilitation, 2012), in addition to the PREDIMED study (Estruch, et al., 2013). The PREDIMED study (Prevención con Dieta Mediterránea) is a Spanish nutritional intervention study that assessed the effectiveness of the Mediterranean dietary patterns in the prevention of cardiovascular diseases by using the 14-item Mediterranean diet score tool (Estruch et al. 2013). Participants were asked to complete the Mediterranean Diet Score tool to calculate their baseline scores out of 14 points. The total score for every individual equals the total score of "Yes" answers.

A PREDIMED Score (Prevention with Mediterranean Diet)) was used in a large Spanish primary prevention trial which included 7,447 Spanish participants

(55–80 years, 58% women) who were at high risk for cardiovascular disease, but otherwise healthy (initially free of cardiovascular disease). The total Mediterranean-diet score equal to or greater than nine indicates high or maximal adherence to the Mediterranean diet, while low adherence to the Mediterranean diet is indicated among participants with a total score that ranges between zero to eight (Trichopoulou, et al., 2014).

Screening instrument for Depression, Anxiety and Stress

The third section of the questionnaires consisted of the Depression Anxiety Stress Scale-21 items questionnaire (DASS-21, Lovibond & Lovibond, 1995). The DASS-21 has seven questions for each of the three disorders, namely, stress, anxiety, and depression to measure the symptoms in each disorder. DASS-21 is an ideal reliable and easy tool for clinical and research purposes. It is a short version of DASS-42 that is a self-report measure that rates the frequency and severity of negative emotions experienced by the participants over the previous week, developed by (Lovibond & Lovibond, 1995).

Participants were asked to record a score for each item between zero and three for the rating scale. Questionnaire 21-items consist of psychological statements applied to the participants over the past week. The rating scale is 0= 'Did not apply to me at all', 1= 'Applied to me to some degree or some of the time', 2= 'Applied to me to a considerable degree or a good part of the time to', 3='Applied to me very much, or most of the time. Scores for each scale were added and multiplied by two to match with the original 42 item scale. Participants were categorised into five groups (normal, mild, moderate, severe, and extremely severe) based on the cut-off scores by Lovibond & Lovibond (1995) as given in Table 2.

Table 2. DASS-21 sub-scale severity rating and severity classification (Lovibond & Lovibond, 1995).

Severity	DASS21-D	DASS21-A	DASS21-S
Normal	0-9	0-7	0-14
Mild	10-13	8-9	15-18
Moderate	14-20	10-14	19-25
Severe	21-27	15-19	26-33
Extremely severe	28+	20+	34+

DASS-21-D: Depression sub-scale of the Depression Anxiety and Stress Scale

DASS-21-A: Anxiety sub-scale of the Depression Anxiety and Stress Scale

DASS-21-S: Stress sub-scale of the Depression Anxiety and Stress Scale

Data analysis

All statistical analyses were conducted using IBM SPSS Statistics for Windows, version 26. P-values of $\leq .05$ were considered statistically significant. The Bonferroni adjustment on p-values value was applied when multiple statistical tests were done on the same data. Descriptive statistics for parametric and non-parametric data tests were used to estimate the sample characteristics such as frequencies, percentages, means, and standard deviations.

Two main tests were used statistically to analyse the main research hypotheses

The relationship between the Mediterranean diet total scores (measured by 14-items Mediterranean diet score tool) and stress total scores multiplied by two among the participants was investigated using Pearson's correlation coefficient as data were normally distributed, see Figure 1. Total scores of stress were multiplied by two as DASS-21 is a short version of DASS-42, and when used the results need to be multiplied for each parameter according to Lovibond & Lovibond (1995). The Kolmogorov test of normality shows that the data was normally distributed (P values $> .05$). The assumption of the homogeneity of variance was accepted Levene's Homogeneity of variance table was consulted, and the P-value is above .05.

The relationships between Mediterranean diet eating habits and the total scores for (anxiety $\times 2$), and (depressions $\times 2$) were investigated as part of the main study hypotheses, see Figure 2 and 3.

The assumption of normal distribution of the data was violated, so, Spearman's Rank Correlation Coefficient test was conducted to analyse the relationship. The Bonferroni adjustment was applied to avoid committing a type one error as multiple tests were used to analyse the data. The new significance P-value = $.05/2 = .025$.

The T-test and the Mann-Whitney U test were used to evaluate the difference of DASS-21 total scores among each two categorical variable groups: males/females, undergraduates/ postgraduates, British/EU/ internationals. One-way ANOVA and Kruskal Wallis tests were performed to check whether the total scores of DASS-21 parameters are dependent on age variation among the participants (three age groups (18-25), (26-30), (31-35) years old).

The Mann-Whitney U test is a non-parametric test that is equivalent to an independent t-test (Pallant, 2001), and it is used to check the difference between two independent groups when the dependent variable is either continuous measure (skewed) or ordinal level of data. A Chi-square test was conducted to analyse categorical data.

One-way ANOVA and post hoc analysis tests were conducted to check the difference between stress total scores among three age groups. The assumption of normality and homogeneity of data was investigated.

The Kruskal-Wallis H test is an alternative to one-way ANOVA analysis of variance between groups for non-parametric data (Pallant, 2001)

RESULTS

Mental disorder symptoms

Table 3 illustrates the frequencies of different severities of mental health symptoms for the three DASS-21 subscales among the participants.

Table 3. Frequencies and descriptive statistics for DASS-21 parameters and symptom severity among the participants (N=125)

DASS21 Parameters	Depression		Anxiety		Stress	
Mean $\pm$ SD	12.9 $\pm$ 9.3		12.6 $\pm$ 8.9		16.4 $\pm$ 8.8	
Minimum	0		0		0	
Maximum	40		36		40	
	Frequency	%	Frequency	%	Frequency	%
Normal	54	43.2%	37	29.6%	55	44%
Mild	17	13.6%	12	9.6%	20	16%
Moderate	25	20%	34	27.2%	27	21.6%
Severe	17	13.6%	16	12.8%	18	14.4%
Extremely Severe	12	9.6%	26	20.8%	5	4%
Total	125	100%	125	100%	125	100%

In total, there is considerable depression, anxiety and stress among the students (above 55% for all categories).

Analyses of the relations of mental symptoms and demographic characteristics revealed, that the level of depression was not influenced by any of the demographic characteristics, i.e. age, gender, study level and nationality ($P > .05$).

The participants' age did not influence the depression, anxiety or stress scores ($P > .05$). One-way ANOVA and a post hoc analysis test showed that there was no significant difference in stress total scores between the three age groups ($P = .09$, $df = 2$). The Kruskal-Wallis H test suggested that the total scores of anxiety ($P = .305$, $df = 2$) and depression ($P = .958$, $df = 2$) among the three age groups were not

significantly different.

Total scores of stress were higher for females versus males ($P = .035$), and for different nationalities ($P = 0.007$, higher for British/ EU students), but did not vary by age and study level ($P = 0.06$).

Anxiety scores were different for under- and postgraduate students ($P = 0.008$, more for undergraduates), and by nationality ($P = 0.007$, more for British/ UK students), but did not vary by age and gender.

By applying the Mann-Whitney U test, the results suggest that there is no significant difference in the total score of stress ($P = .06$, $Z = -1.9$) and depression ($P = .297$, $Z = -1.04$) among two study levels (undergraduates, postgraduates).

Table 4. Adherence to the Mediterranean Diet (N=125): Frequencies and percentages of individual responses.

Recommendations of the Mediterranean diet	Frequency (yes)	Percentage %
1-Is olive oil the main culinary fat used?	75	60%
2- Are ≥ 4 tablespoons of olive oil used each day?	44	35.2%
3- Are ≥ 2 servings (of 200g each) of vegetables eaten each day?	79	63.2%
4-Are ≥ 3 servings of fruit (of 80g each) eaten each day?	64	51.2%
5-Is < 1 serving (100-150g) of red meat/ hamburgers/ other meat products eaten each day?	70	56%
6- Is < 1 serving (12g) of butter, margarine or cream eaten each day?	65	52%
7- Is < 1 serving (330ml) of sweet or sugar sweetened carbonated beverages consumed each day?	70	56%
8- Are ≥ 3 glasses (of 125ml) of wine consumed each week?	45	36%
9- Are ≥ 3 servings (of 150g) of legumes consumed each week?	53	42.4%
10- Are ≥ 3 servings of fish (100-150g) or seafood (200g) eaten each week?	49	39.2%
11- Is < 3 servings of commercial sweets/pastries eaten each week?	81	64.8%
12- Is ≥ 1 serving (of 30g) of nuts consumed each week?	48	38.4%
13- Is chicken, turkey or rabbit routinely eaten instead of veal, pork, hamburger, or sausage?	84	67.2%
14- Are pasta, vegetable or rice dishes flavored with garlic, tomato, leek, or onion eaten $\geq$ twice a week?	109	87.2%
	Mean	SD
PREDIMED SCORE	7.5	2.2

Table 5. The adherence to the Mediterranean diet among participants by demographic variation

The adherence to the Med diet	0 - 8 (low)	≥ 9 (high)	Total
(Mean $\pm$ SD)	6.35 $\pm$ 1.3	10.2 $\pm$ 1.2	7.5 $\pm$ 2.2
Total Number	88	37	125
Total Percentage%	70.4%	29.6%	100%
Undergraduate students number	70	31	101
Postgraduate students number	18	6	24
British/EU students number	70	29	99
International students number	18	8	26
Males number	23	7	30
Females number	64	29	93
Prefer not to say number	1	1	2
Student aged between 18-25	72	28	100
Student aged between 26-30	11	5	16
Student aged between 31-35	15	4	9

Adherence to Mediterranean diet

Table 4 shows the frequencies and percentages of the participants' responses for the 14-items Mediterranean diet tool. The participants were not highly adherent to the Mediterranean diet

Only 29.6% of the studied population had a total PREDIMED score $\geq$ of 9 for the 14-items Mediterranean diet questionnaire indicating a good adherence to a Mediterranean diet (Table 5). It seems younger, female, British/ EU and undergraduate students are more likely than others to adhere to a Mediterranean diet.

Exploratory analyses revealed that females consumed fewer soft drinks and nuts than males. The percentages of males and females who consumed < 1 serving (330ml) of sweet or sugar-sweetened carbonated beverages per day were 36.7%, and 61.3%, respectively ($P = .018$). The adherence to the Mediterranean diet recommendation regarding nuts (≥ 1 serving of 30g of nuts consumed per week) was higher among males (53.3% responded "Yes") than females (33.3% responded "Yes", $P = .05$)

The only difference between undergraduates and postgraduates regarding the Mediterranean diet recommendations was the usage of more olive oil as a main culinary lipid in the undergraduates (56.7% versus 33.3%, $P = .004$).

The biggest difference in the adherence to the Mediterranean diet style of eating was observed by comparing British/EU and international students. The Chi-square test has shown a significant difference in the response to 4-items out of 14-items of the Mediterranean diet score tool between British/EU and internationals. These were the use of olive oil as a main culinary lipid ($P = .04$, $df = 1$), fruits consumption ($P = .024$, $df = 1$), nuts and legumes consumption ($P = .04$, $df = 1$), and fish and seafood eating ($P = .02$, $df = 1$). The former two were higher among British/ EU students; the latter two were higher among international students.

Relationships between mental disorder sub-scores and diet

Our assumption of a relationship between mental disorder scores and adherence to the Mediterranean diet were not confirmed:

The Pearson's rank correlation coefficient test

indicated that the relationship between the Mediterranean diet total scores and stress (stress total scores $\times 2$) was not significant ($r = .13$, $P = .16$). Coefficient of determination for a total score of stress and the Mediterranean diet total score indicated 1.7% shared variance. Therefore, there is no relationship between the Mediterranean diet eating habits and stress among the participants.

According to Spearman's rank correlation coefficient, there was no correlation between the Mediterranean diet eating habits and anxiety ($r = .163$, $n = 125$, $P = .069$). The coefficient of determination for total scores of (anxiety $\times 2$) and the Mediterranean diet total score = 2.6% shared variance.

Similarly, there was no correlation between the Mediterranean diet and depression as shown by Spearman's rank correlation coefficient ($r = .171$, $n = 125$, $P = .057$). The coefficient of determination for total scores of (depression $\times 2$) and the Mediterranean diet total score = 2.9% shared variance.

Figures 1 to 3 indicate the relationships between stress, anxiety and depression (DASS-21 sub-scores), and adherence to the Mediterranean diet.

Individual diet adherence, wine and mental health symptoms

Even though there was no significant relationship between the Mediterranean diet total scores and the total scores of stress, anxiety, and depression, further analyses showed that only few psychological symptoms are related to some of the Mediterranean diet styles of eating. The data is not shown but is available from the author.

However, a negative but relatively consistent correlation was detected between wine drinking habits, according to the Mediterranean diet recommendations, and psychological symptoms measured by DASS-21. Moderate wine drinking habits were protective against four out of seven symptoms for each scale of stress, anxiety, and depression.

Wine consumption according to the Mediterranean recommendation (glasses ≥ 3 glasses /week), was protective against some stress symptoms: Hard to wind-down (P value = .047); Nervous energy (P value = .007); Agitation (P value = .009); Felt touchy (P value = .008).

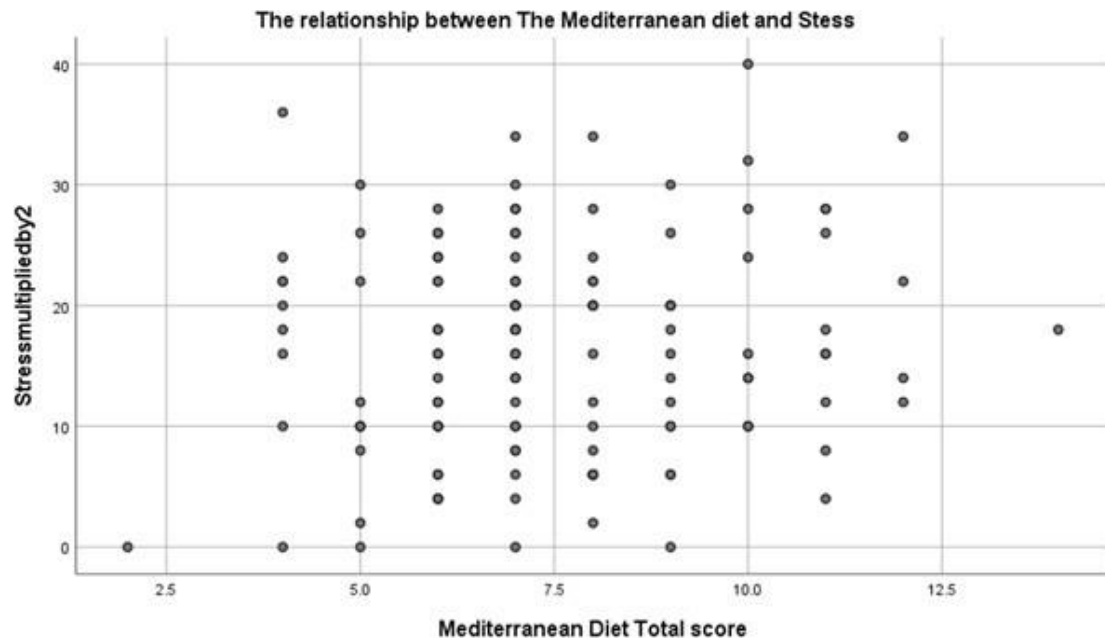


Figure 1. There is no significant linear relationship between the Mediterranean diet and stress Pearson's rank correlation coefficient ($r = .13$, $P = .16$)

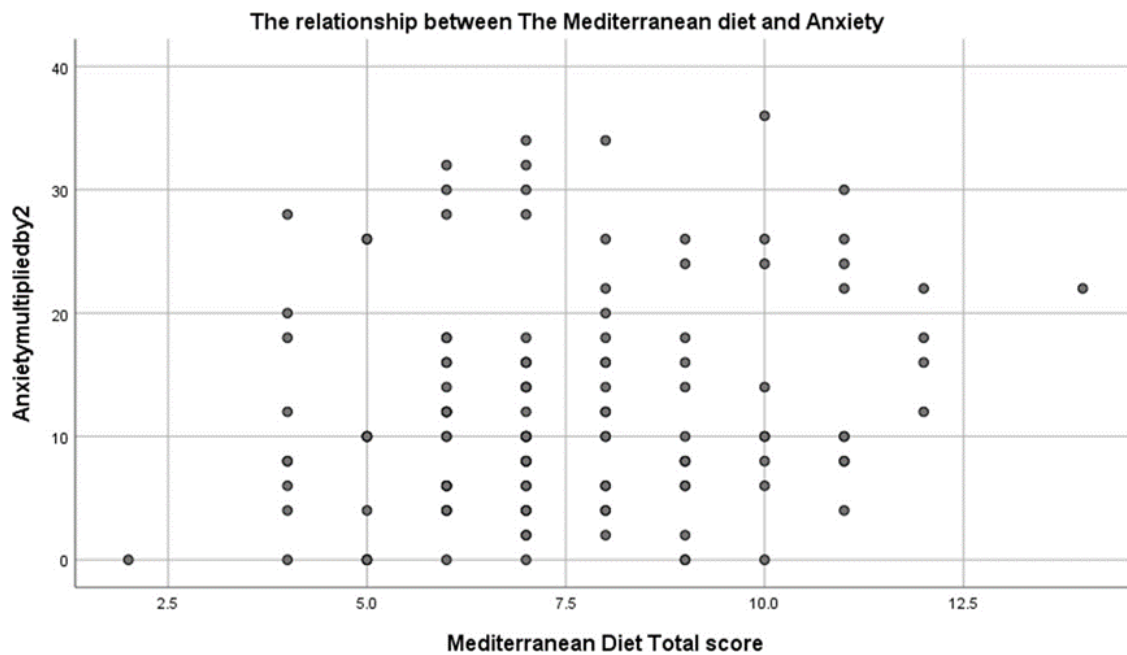


Figure 2. There is no significant linear relationship between the Mediterranean diet and anxiety Spearman's rank correlation coefficient ($r = .163$, $n = 125$, $P = .069$)

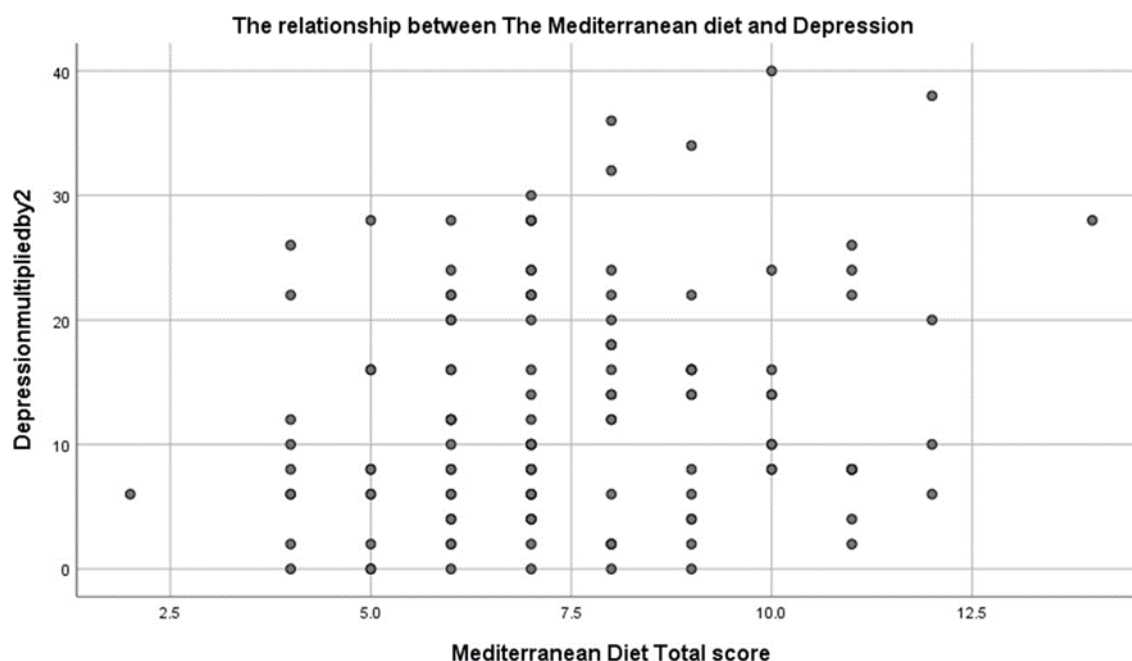


Figure 3. There is no significant linear relationship between the Mediterranean diet and depression Spearman's rank correlation coefficient ($r = .171$, $n = 125$, $P = .057$)

Wine consumption according to the Mediterranean recommendation (glasses ≥ 3 glasses /week), is protective against some anxiety symptoms: Hand trembling (P value $= .038$); Close to panic (P value $= .033$); Unusual heartbeats (P value $= .013$); Scared with no reason (P value $= .024$).

Wine consumption according to the Mediterranean recommendation (glasses ≥ 3 glasses /week), is protective against some depression symptoms: No positive feelings (P value $= .008$); Nothing to look forward to (P value $= .047$); Down hearted & blue (P value $= .02$); Not worth much as a person (P value $= .02$).

DISCUSSION

The Mediterranean diet is a healthy nutritional pattern that is described by a high intake of vegetables, legumes, fruits, nuts, grains, fish, extra virgin olive oil, moderate consumption of red wine, and minimum consumption of red meat (Schwingshackl, et al., 2019). The Mediterranean diet is protective against cardiovascular diseases, cancers, and metabolic diseases (Schwingshackl, et al., 2019). Furthermore, the Mediterranean diet has been associated with a lower risk of mortality and improves general health and sleep quality (Muscogiuri, et al., 2020).

The present study has shown that adherence to Mediterranean dietary eating habits is not related to mental health disorder symptoms (stress, anxiety, and depression) among young university students at the University of Chester/UK. Additionally, even though the adherence to the Mediterranean diet among the participants in the present study was relatively low, it was not associated with stress, anxiety, or depression symptoms among the participants.

Comparable findings to the present study were reported by (Shafiei, et al., 2019) meta-analysis as it was concluded that adherence to the Mediterranean diet is not protective against depression. On the other hand, (Antonopoulou, et al., 2020) study has shown that a high adherence to the Mediterranean diet was correlated with lower depression risk, and a higher perceived stress score was related directly to low fruit and vegetable intake. Even though (Antonopoulou, et al., 2020) findings contradict the results and conclusion of the present study, some mental health protective benefits were gained and detected in the present study from adherence to the Mediterranean diet. For example, eating more than three servings of fruits per day was protective against some stress and anxiety symptoms. In addition to the previous example, some anxiety symptoms were negatively associated with the daily consumption

of four tablespoons of olive oil. Another study of systematic reviews and meta-analysis of more than four million participants suggested that increasing the adherence to the Mediterranean diet eating habits by two points (out of 14) can reduce the risk of depression by 32% (Dietitians of Canada, 2018); this contradicts the findings of the present study. As mentioned above, the findings from the present study are comparable with the systematic review and the meta-analysis conducted by (Shafiei, et al., 2019) as it was found that adherence to the Mediterranean diet and depression risk is not related among the analysed cohort studies. However, the meta-analysis of the cross-sectional studies (Shafiei, et al., 2019) has shown that the association between adherence to the Mediterranean diet and depression odds was inversely related which contradicts the findings from the present study. The present study has concluded that adherence to the Mediterranean diet is not protective against mental health disorder symptoms.

However, the present study has shown that moderate intake of wine was associated with lower symptoms of mental health disorders among the participants which is a comparable to the findings of Gea, et al. (2013). Moderate alcohol consumption spread over the week, and a preference for a red wine, with meals is recommended by the Mediterranean diet style of eating (Hoffman & Gerber, 2016). The avoidance of binge drinking is also a key factor in the Mediterranean diet's way of healthy drinking habits (Hoffman & Gerber, 2016). Similarly, a cohort study of 5,505 men and women (55-80 years old) of the PREDIMED trial conducted over seven years concluded that low and moderate consumption of alcohol, particularly wine, can reduce the incidence of depression (Gea, et al., 2013). Although the conducted cohort has demonstrated that moderate wine consumption is protective against mental health disorders, the risk of depression was higher among heavy drinkers included in the study. Brief information has been obtained from the participants in the present study regarding their drinking habits. However, the benefits of moderate wine consumption on their mental health are evident. Therefore, moderate wine-drinking habits can have protective effects against psychiatric conditions among young university students. More studies are required to evaluate this finding to draw a clear conclusion in the aspect of wine consumption and psychological conditions among this group.

There are some study limitations. For example, the

impact of the pandemic (COVID-19) deterred the extent of the current research project. The required target sample size to conduct the study was (377-400) based on the Krejcie & Morgan formula (1970) to determine the sample size. However, only 125 data samples were collected from two campuses, mainly, the Parkgate Road campus and Riverside campus rather than all four university campuses. The researcher had to limit the time spent with the participants to avoid risking the transmission of the Coronavirus during the pandemic. As a consequence, the verbal explanation of the study's purpose was very brief, and the participants depended more on the written information in the participant information sheet. Safety precautions were taken, for instance, a face mask and gloves were worn while approaching the participants. The research activity took place in an open-air space rather than inside the university premises (library, student halls, and the university gym).

Although it was concluded in this study that the Mediterranean diet is not related to stress, anxiety, and depression symptoms among young university students in the UK, further investigations are required to generalise this theory. The current evidence is not sufficient to prove that the Mediterranean diet cannot prevent stress, anxiety, and depression.

CONCLUSIONS

Adherence to the Mediterranean diet eating habits is not related to mental health disorder symptoms. The Mediterranean diet style of eating does not increase the risk or protect against developing psychological disorders among young university students in the UK. However, the results of this study have shown moderate consumption of wine according to the Mediterranean diet recommendations is protective against some psychological disorder symptoms (stress, anxiety, and depression) among young university students. Socio-demographic factors such as age, gender, study level, and home backgrounds have an influence on the participants' Mediterranean diet eating habits, and more importantly, their mental health. Confounding factors could have an influence on the results of the study, therefore, they should be adjusted and understood deeply to create successful strategies that aim to prevent mental health disorders among young university students in the UK. Further studies are required to confirm the result of the present study, such as prospective cohort or interventional studies.

DECLARATIONS

Acknowledgements: We would like to express deepest thanks to the participants who deserve the acknowledgement for their contribution in helping to collect the required data.

We would like to extend our gratitude to Prof Reiner Heun (Editorial Board GLOBAL PSYCHIATRY ARCHIVES) for his extraordinary and generous support in reviewing the paper twice and providing precious advices for the authors regarding the paper's various details.

Authors' contributions: The lead author worked on the research independently under the supervision of Prof Stephen Fallows (Programme leader).

Availability of data and materials: The data that support the findings of the study are available on request from the author. The data are available on an SPSS file saved by the author.

Competing interests: Not applicable

Ethical Approval: Ethical approval was granted by the University of Chester Faculty of Medicine and life sciences Ethics Committee before proceeding with the research project. Some ethical issues, such as safety, were discussed by the ethics committee members, and solutions were agreed on. The safety of the participants and the researcher was a priority. For example, the DASS-21 questionnaire was a source of concern for the distress risk that it might cause among some participants as it contains sensitive questions about some psychological disorders' symptoms. The solution was to stop filling the distressing questionnaire form, apologise to the affected individual and offer help if needed. For example, the researcher can offer advice to the distressed individual to seek professional help by contacting the university Wellbeing for students' service. However, the mentioned ethical issue was not encountered by the researcher while collecting the data. Wellbeing help-line numbers and information about their working hours were provided at the end of the questionnaire set to provide awareness about the services offered by the university as some students, especially freshman year students, and international students, might not be aware of it.

Funding: Not applicable. The research was done as part of the author's master's degree at the University of Chester/ Chester/ UK. The author is an international

student who paid for her tuition fees (self-financed).

Informed consent: Students were approached directly by the lead researcher and were invited to complete the questionnaires after taking their written consent to participate.

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